Center Innovation Fund: JPL CIF

Deep Network Radiative Transfer: A Revolution in Imaging Spectrometer Atmospheric Correction

Completed Technology Project (2017 - 2019)

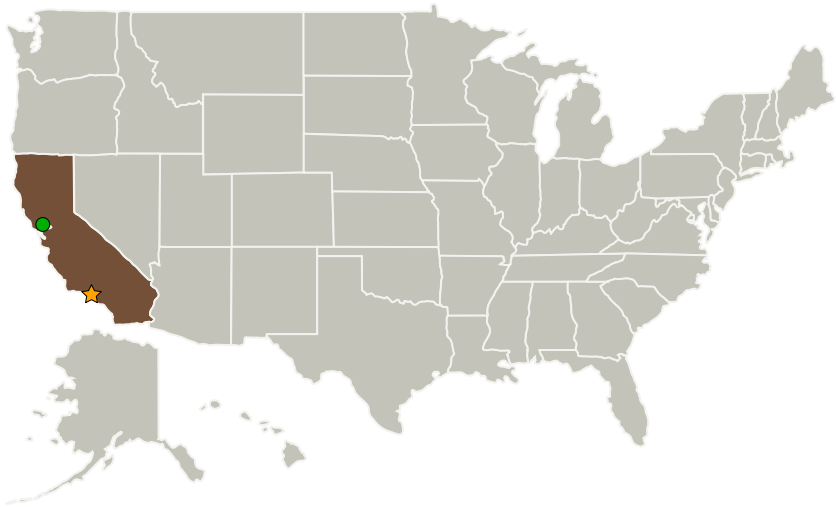
Project Introduction

Enables accurate Maximum A Posteriori inversion. Leverages full spectral information to estimate smooth perturbation from scattering, coupled BRDF. Trained "forward model" captures rigorous physics interpretation of underlying RTM.

Anticipated Benefits

Visible Shortwave Infrared (VSWIR) atmospheric correction is key for global terrestrial & aquatic ecosystem studies. Capability need: 2 order of magnitude speedup. 0.1 seconds per iteration enables accurate iterative numerical inversion. Potential applications include: • Atmospheric correction for airborne VSWIR spectrometers (AVIRIS-NG, AVIRIS-C, ACIS, and future instruments). • Orbital VSWIR spectrometers (EMIT, SBG) • Extensible to water column modeling for ocean color, inland water quality, and coastal ecosystem studies (PRISM, CORAL, PACE, EV-S proposals) • Extensible to thermal IR for HyTES and longwave IR imaging spectrometers for Earth and planetary

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
Universities Space Research Association(USRA)	Supporting Organization	R&D Center	Huntsville, Alabama
University of Massachusetts-Amherst(UMASS)	Supporting Organization	Academia	Amherst, Massachusetts

Primary U.S. Work Locations
California

Project Transitions

October 2017: Project Start

September 2019: Closed out

Closeout Summary: Atmospheric Radiative Transfer Models (RTMs) are compu tationally-complex simulations of photon transport in the atmosphere which are critical for estimating spectroscopic surface properties remotely from air and spa ce platforms. They will be important for imaging spectrometer missions slated to fly in the early 2020s (e.g. NASA's EMIT mission) and investigations planned for later in the decade (e.g. the Surface Biology and Geology Decadal Observable). However, such instruments produce data volumes that are not currently possibl e to analyze using our most accurate RTMs due to the extreme computational ex pense. This project uses machine learning strategies to provide multiple orders-of-magnitude improvements in RTM speed at negligible loss in accuracy while re taining the physical interpretability of the underlying physics-based model. We t rained a neural network to emulate the physics-based solution over a relevant r ange of atmospheric conditions and observation geometries. This enables enhan ced retrievals of surface properties under challenging atmospheric distortions.

Project Website:

https://www.nasa.gov/directorates/spacetech/innovation_fund/index.html#.VC

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Center / Facility:
Jet Propulsion Laboratory (JPL)

Responsible Program:
Center Innovation Fund: JPL CIF

Project Management

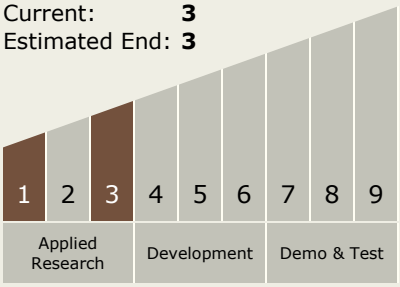
Program Director:
Michael R Lapointe

Program Manager:
Fred Y Hadaegh

Principal Investigator:
David W Thompson

Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  - TX05.1 Optical Communications
    - TX05.1.5 Atmospheric Mitigation

Target Destinations

Earth, Others Inside the Solar System, Outside the Solar System